MIP: THE EXEMPLAR FOR ARMY TRANSFORMATION TO NET-ENABLED BATTLE COMMAND

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ABSTRACT

The Multilateral Interoperability Programme (MIP) provides an example and has mature products available to the various DoD development communities forming Communities of Interest (COI), for the purpose of developing information systems interoperability.

1. INTRODUCTION

The Army is in the middle of transforming from a heavy forward deployed cold-war force to a smaller, lighter, lethal and effective expeditionary force to meet all future threats and missions from full scale war to support to civilian authorities. The Army's Transformation Roadmap provides the guiding principles to shape the research, development, and experimentation to achieve that vision by describing the attributes of that future force. "Modular, capabilities-based unit designs; the Force Stabilization and Unit Manning System; and networked battle command capabilities are three examples of ongoing Army efforts to create smaller, faster, lighter, and more lethal Army forces for interdependent joint operations now and into the future." (U.S. Army, 2003) The Army's Transformation efforts are driven by The Future Joint Force Attributes; Integrated, Expeditionary, Networked, Decentralized, Adaptable, Decision Superior, and Lethal. (Joint Operations Concepts, 2003) The Army's future information systems must also transform battle command systems to support future operations to be successful trading armor and fire-power for agility and information superiority. Figure 1-1 shows the Army Transformation Roadmap's view of how technology will enable Battle Command. This puts the battle command information systems on the critical path to a successful and effective transformed future Army force that is lighter, more agile, and more survivable. The Army's Net-Enabled Battle Command for the future envisions easy access and use of data from all sources, including Joint, Coalition, government agencies and Non-Government Organizations (NGO), creating new problems in collection, management, and applications developments to integrate data from dispirit sources into a coherent integrated view of the situation. Interoperability is a key enabler for the Future Army Battlefield Information System. "Achieving and sustaining information superiority requires interoperability within the transforming Army, and between Army forces and those of other Services and nations."
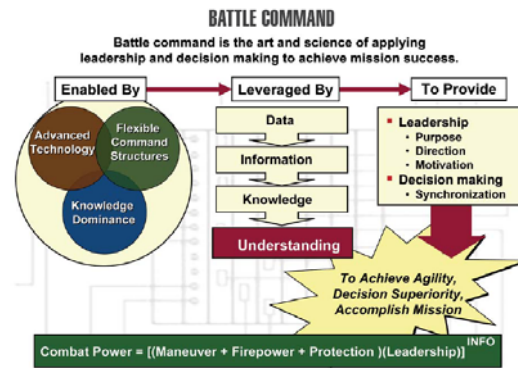

Figure 1-1 Relationship between Battle Command and Technology (Army Transformation Roadmap, 2003)

2. FUTURE JOINT FORCE ATTRIBUTES AND GOVERNANCE

Each of the Joint Future Joint Force Attributes of Integrated, Expeditionary, Networked, Decentralized, Adaptable, Decision Superior, and Lethal are enabled or constrained by the information, information processing, information use (applications) in addition to the actual systems and systems interconnections. Of the seven Future Joint Force Attributes, six are not obtainable without a "Network-Enabled Battle Command" capability, which relies on the seamless availability of integrated data from all sources. The DoD Net-Centric Data Strategy was developed to address this problem based on a market driven approach. DoD recognized that a new methodology was required to achieve

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interoperability based on its past experience in trying to manage data at the enterprise level. (DoD Net-Centric Data Strategy, 2003) The market driven net-centric data strategy approach was based around the concept of communities of interests. A COI can be defined as a collaborative group of users who must exchange information in pursuit of their shared goals, interests, missions or business processes and who therefore must have shared vocabulary for the information they exchange. (Wikipedia, 2006) This approach is based on the idea that the producers and consumers of information will naturally come together and agree to a commonly useful group of information based on their individual system's needs. A key goal of the strategy was to migrate from "point-to-point" exchanges to "many-to-many" exchanges between information producers and consumers. (DoD Net-Centric Data Strategy, 2003) COI's are still in their infancy, being formed, based on need, but without role models to help organize the work flow and the resulting documentation. "The difficult task is to stand up the COIs and to establish the data models. A couple of pilot COIs are working toward those goals, but that clearly is the challenge for the department. We now have a 'buy' on the strategy; we have a directive out; and the three services have said that they agree with the strategy and the directive. Now we have to start standing up the communities of interest," says Michael Krieger, director of information management in the office of the Defense Department deputy chief information officer.(Signal, 2005) Unfortunately, the DoD Net-Centric Data Strategy's Market Driven concept was developed without a detailed existing exemplar pattern or the concept of integrated data. *The Open Source software movement, as described in "The World is Flat", is a collaborative development concept described as one of the 10 world flattening technologies, might be used as an example COI, but they typically are developing applications not data standards.*

"The Net-Centric Data Strategy meets this challenge by focusing on data, rather than on the proprietary applications and programs that manipulate data (the current focus). Those at the source of the data will be required to make it easy to find and use. It must be: visible, accessible, and understandable."(DoD Net-Centric Data Strategy, 2003) With our nation at war, we need useful solutions now, can't afford to fall into the old trap of if you want it bad,

that's how you'll get it. The absence of enforceable directives and architectural mandates would seem to be a serious inhibitor in achieving interoperability. Coalition or multinational interoperability should be a more difficult than interoperability between DoD services, however this doesn't seem to be the case. The Multilateral Interoperability Programme (MIP) has developed and demonstrated significantly capabilities based on their own market-driven development of open source specifications.

3. THE MULTILATERAL INTEROPERABILITY PROGRAMME (MIP)

MIP was established by the Project Managers for the Command and Control Information Systems (C2IS) of the armies from Canada, France, Germany, Italy, the United Kingdom and the United States of America in 1998. MIP is not a formal NATO program but a voluntary and independent activity by the participating nations and organizations, which includes NATO. The nations and HQs that are active in MIP are: Australia, Austria, Belgium, Bulgaria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, United Kingdom, United States and NATO Allied Command Transformation (ACT). (http://mip-site.org, 2006) MIP was created based on a market-driven need and provides DoD, the Army, and industry an exemplar of how and what a COI can and should accomplish. MIP demonstrates the value and effectiveness of the "Market Driven Approach" to an interoperability problem with results greater than merely connecting information sources. MIP, like the open source community, was created and continues to grow based on the participant's needs and participation.

3.1 MIP as COI

Command and Control Information Systems (C2IS) have long needed interoperability as a key enabler to be effective. "Interoperability is the key enabler that allows the Joint Force to remain dominant across the entire spectrum of military operations." (Army Transformation Roadmap, 2003) MIP is focused on enabling multinational information exchange facilitating national advances in the state-of-the-art for C2IS development. "The aim of the Multilateral Interoperability Programme (MIP) is to achieve

international interoperability of Command and Control Information Systems (C2IS) at all echelons from corps to battalion, or lowest appropriate level, in order to support multinational (including NATO), combined and joint operations and the advancement of digitization in the international arena." (http://mip-site.org, 2006) MIP has produced the baseline set of specifications defining its Block 2 capability, which has been implemented, tested and is in the process of being fielded in national C2IS's. MIP as a collaborative program supports the open exchange of information between concept developers, requirements engineers, and finally the system developers of each nation's C2IS leading to a greater capability for each participating C2IS.

3.2   MIP is Market-Driven.

MIP is functionally organized, employs a tailored life-cycle model, and develops open source technologies and specifications, proven in a testing forum, to achieve success in multinational interoperability. MIP serves as an exemplar for organizational constructs, processes, products, and validation forums, and demonstrates the value and effectiveness of an interoperability approach that has demonstrated results greater than merely connecting information sources to consumers. Thomas Freedman describes the Open Source/Free Software phenomenon where practitioners' and developers collaborate to build superior products in his book "The World is Flat". MIP is an example of this phenomenon placing DoD in a position to take great advantage internally while gaining interoperability with the other 24+ mission partners who also take advantage of MIP products.

MIP was established to address and overcome all of the technical and operational issues and barriers to achieving information sharing between coalition land forces based upon an operational mission relationship. There are significant barriers, technical, organizational, and cultural. The collaborative processes employed by MIP overcome these obstacles by peers collaborating, from each participating nation, to identify requirements, develop specifications, and conduct testing, ultimately to realize a fieldable capability for the Tactical C2IS of the adopter nations. MIP assembled the right participants from the user community, systems engineers, and developers to develop a full life-cycle that nations could adopt and integrate with

their own national systems. The solution being developed by MIP overcomes the barriers of language, operational doctrine, organizational constructs, networking protocols, data format, and programming languages.

The end-state integration and use of MIP researched and developed technologies is a set of capabilities that enables a deployed Army commanders and staff coordination and understanding through information sharing and collaboration with multinational mission partners. Each full member nation agrees to incorporate and deploy (field) their Command and Control Information System with the MIP Solution.

There are 4 principle components that are the result of MIP research and development activities; 1) Organization, 2) Process, 3) Products (specifications), and 4) a testing forum to validate compliance to the specification, validate the requirement, and develop the Tactics, Techniques, and Procedures (TTP) for successful deployment and use of the capability.

3.3   MIP Organization

MIP is a functionally based organization covering management, user requirements, high level design, low level design, and testing. MIP is organized into 5 working groups with an executive management body and a high level steering group for resources, policy and targets. At the working group level, the Multidisciplinary Working Parties (MDWP) with experts from the various Working Groups is the paradigm. These MDWPs can be created at the behest of either the MIP Steering Group or Program Management Group for particular tasks and will draw their resources from the existing working groups. (http://mip-site.org, 2006)

Collaboration between MIP participants in the development of the MIP Specifications is the key to the development of the technology and descriptive specifications that has resulted in the products that has made MIP successful. The contribution for each participant is subject matter expertise that participates in Working Groups and Working Parties. Each Full MIP Member agrees to support each Working Group with at least one voting member and the Chairman or Deputy Chairman as directed. Observer Members may participate in Working Groups with as many or few non-voting members as they choose. By fully supporting this activity, a

member is able to take advantage of one member's strengths and make for a specific national weakness in any one technological area.

The Working Groups provide the manpower and subject mater expertise to produce the baseline documents. The Working Groups are:

- The Operational Working Group (OWG) who represents the end user and documents the functional and Information Requirements in the MIP Tactical Information Requirements (MTIR).

- The Systems Engineering and Architecture Working Group (SEAWG) forward engineers User Requirements and documents technical solutions in the MIP Systems Requirements Specification (MSRS) and the MIP Technical Interface Design Plan (MTIDP).

- Data Modeling Working Group (DMWG) evolve the MIP Information Requirements to data solutions documented in C2IEDM and the JC3IEDM Documents.

- Test and Evaluation Working Group (TEWG) plans and executes all test activities documented in the MIP Test and Evaluation Master Plan (MTEMP) MIP Configuration & Control Working Group (CCWG) maintains the MIP Library and the MIP Document Register.

The US Army has adopted and integrated the basic developmental organizational construct developed in MIP to address a number of Command and Control concept and developmental issues within the Army. The Warfighter Mission Area (WMA) has successfully adopted this organizational construct to bring various agencies and activities together to solve common problems in a non-competitive environment. (Whitehead, 2006) The success of this group and its organizational construct has encouraged adoption to other developmental activities to include JFCOM. The MIP Organization and Processes are tightly coupled for a smooth process with clear delineations of responsibility, overseen by a management group. The MIP Organizational construct has a MIP Steering Group (MSG)

providing the overarching guidance and executive support. The MSG meets twice a year. The Programme Management Group (PMG) provides synchronization and oversight functions ensuring the cost (national problem), schedule, and performance is considered and managed. The PMG maintains a synchronization matrix that tracks national C2IS versions, fielding dates, with MIP Solution version. The PMG and all Working Groups meet four times a year to accomplish their mission.

3.4   MIP Processes

MIP has developed processes and products that overcome organizational and technical barriers to effective and efficient operations. A set of processes had to be researched and developed to facilitate the development of solutions to these complex problems. The information system developmental process, at a macro level, is a variant of the Rational Unified Process (RUP). The process has been tailored extensively to facilitate the international collaborative nature of the overall purpose and intent. The MIP process is a mini life-cycle, covering user need identification, systems engineering, to low-level design. The corresponding tests criteria is developed to verify each level of design ensures implementations are both compliant and necessary. The process is focused on the development of specifications that begins with a doctrinal functional need through the definition of the information exchange, with the corresponding test cases to validate the capability from technical implementation to operational use.

User requirements and concepts are developed, use case models are used where necessary. User Requirements are then forward engineered into testable specifications at the operational, system, data, and protocol levels. Specifications are frozen, and the implementation timeframe is executed where national developers complete their solutions. The test cycle begins with low-level protocol testing over the internet and ends with an Operational Level Test (OLT) using surrogate army units. Multi-disciplinary Working Parties (members from all effected Working Groups) ensure a smooth transition of effort from Working Group to Working Group, from phase to phase, without loss of intent or purpose. This comprehensive process ensures the most robust and optimal solution is available for fielding, soonest.
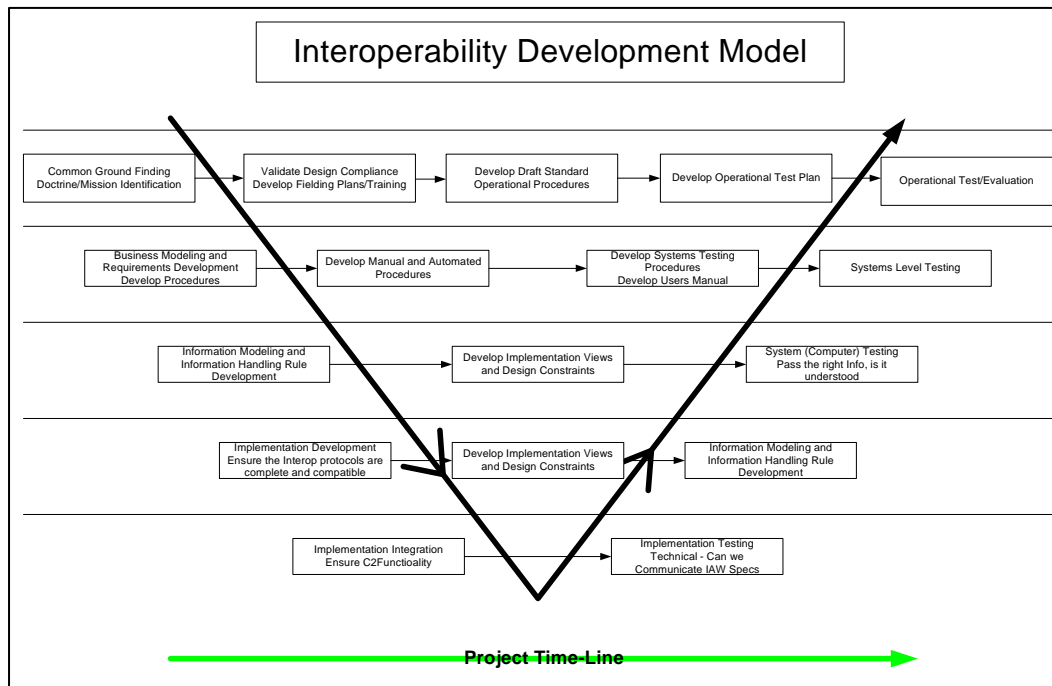
Figure 3.4-1 View of the MIP Interoperability
Development Model

Regardless of the style or "design pattern" selected, any enterprise system/system of systems, all require a common language or data structure (understood or used by all systems) in order for the applications to create and use persistent data, exchange system commands, status, services, etc. One of the first activities that must be completed when designing and building an information system is defining the information infrastructure. Having a common definition for Combat Developers, System Engineers, and System Developers enhances communications and reduces ambiguity in the discussion of what the system is to do. Developing a common data dictionary is the first step in breaking this trend and provides an ambiguous language (modeling) for use between business analysts (Combat Developers), Designers (System Engineers), and Developers (Programmers) resulting in more capability, fewer errors, less cost, and less time to delivery.

3.5   MIP Products

The results of the efforts of the MIP Working Groups are key requirements and specifications based on the national functional needs, not current national implementations. This approach keeps the MIP development as a "leading activity" instead of continually trying to catch-up, band-aiding multiple less than optimal

solutions. The net result is that MIP serves as an international research and development activity that is more rapidly evolving C2IS concepts and the implementation of Net-Enabled Battle Command than what any one national could accomplish alone. MIP provides a set of Open Source specifications that allows any interested party to develop a MIP Solution. Each MIP participant develops their own system. The Open Source nature of the MIP specifications has resulted in at least two private businesses developing Commercial Off the Shelf (COTS) C2 systems for sale to military and civil authorities. The MIP developed specifications and implementation standards have undergone a rigorous regimen of testing from low-level protocol to use in operational scenarios. The MIP specification of greatest interest is the information exchange data model, the current version being the Command and Control Information Exchange Data Model (C2IEDM) which has evolved to the Joint Command, Control, and Consultation Information Exchange Data Model (JC3IEDM). The common data model provides the information construct necessary for an integrated data and the ability to achieve an effective Net-Enabled Battle Command capability. NATO and the U.S. Army have formally adopted the MIP produced data models as its information infrastructure for all future systems development.

The JC3IEDM and its predecessor the C2IEDM are the central specifications that provide the most reuse and potential for national and international leverage. The data models developed by MIP have been adopted by NATO as their information standard, and by most of the nations participating in MIP for the basis of their internal data model along with at least 2

commercial off the shelf C2IS applications. The MIP developed JC3IEDM has been adopted and endorsed by the US Army G3 and G6 as the US Army interoperability standard. This data model will provide for the information integration that will make the DoD Net-Centric information exchanges a complete story that is in context and useful to deployed commanders and staffs.

3.6 MIP Testing Forum:

The MIP Testing Forum provides a common location, time, scenario, and facility for developers and trainers to work together with the C2IS's, developers, and soldiers, from other nations to achieve and demonstrate the interoperability capability that is developed as a result of the MIP research and developments. There is no other forum where this collaboration and coordination occurs.

3.7 MIP in Practice

The MIP organization, process, products, and implementations have been validated through a series test events. The final MIP Operational Level Test for MIP Block 2 was completed in May 2006, where 14 countries tested with 18 different systems, paving the way for MIP deployments to operational theaters. (http://mip-site.org, 2006) A number of nations and NATO are in the final planning stages of deploying MIP compliant solutions to Afghanistan beginning 2QFY07. Once completed, MIP gateways will link CENTCOM with NATO's International Security Assistance Force (ISAF) headquarters; ISAF to the US led CJTF, and then allow the dynamic linking lower echelon forces where command, support, or proximity relationship exists, such as between US brigades with the French and Multinational (CAN, GBR, & NLD) Brigades that are ISAF

subordinates. Figure 3.7-1 shows a set of screen shots from a set of MIP demonstration using US, Canadian, and Portuguese command systems.
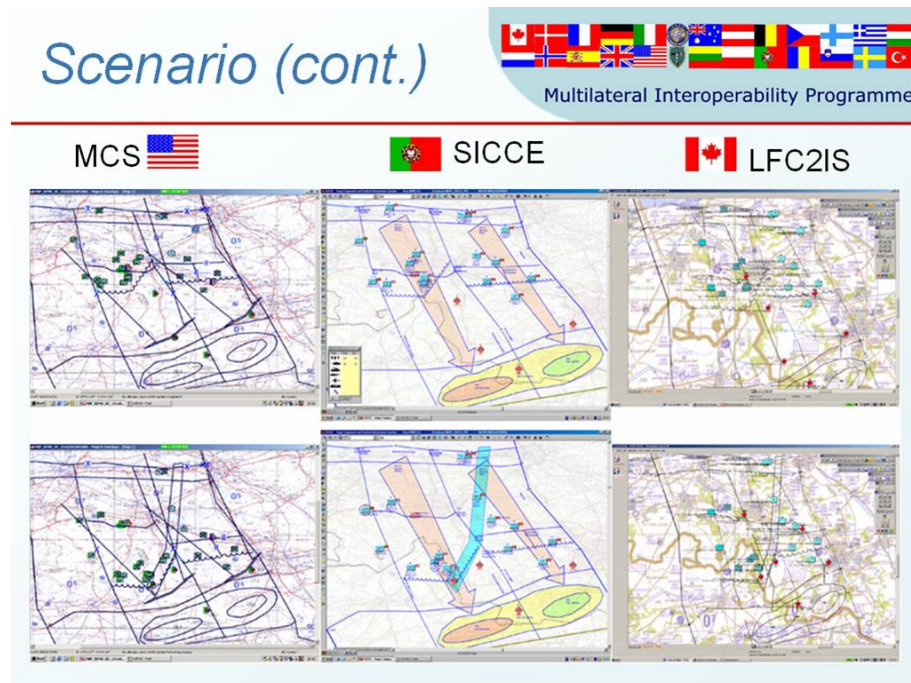

Figure 3.7-1 United States, Canadian, and Portuguese command systems displaying the current situation using MIP Data

NATO Data Administration Group (NDAG), who is an associate member, has adopted many of the MIP developed specifications, principally the data model, and has promulgated them as STANAG proposals. The NATO C3 Agency, who is responsible for the development of NATO's C2IS, also an associate member, has developed a prototype NATO C2IS, the Land Command & Control Information System (LC2IS), based on the MIP data model and information exchange techniques (message and data), that is fully MIP Compliant.

The Army is investigating the establishment of forums to assist non-Europe based mission partners (nations and organizations) to understand, influence, and develop a MIP capability. As a precursor, the MIP capability was used in the American, British, Canadian, and Australian Army (ABCA) exercise in Australia, September '06.

3.8 Future Army Impacts:

The fundamental information systems science work done by MIP to develop the JC3IEDM has opened the possibility to deliver new and badly needed capabilities to Army unit leaders. The integrated information set provided by the JC3IEDM will allow users in the field unparalleled access to related information threads that are currently so labor intensive, that deployed units rarely have the luxury to accomplish. Integrated information provides the underpinnings that enable Network Analysis supporting Effects Based Operations, Automated Risk Identification (Running Estimate), simulations-current operational interface, Automated Plans and Orders, and other highly information centric processes and products that are currently too hard to do. The MIP community has demonstrated the feasibility and utility of integrating battlefield information as a force multiplier with more uses than exchange and display. This demonstration of the power and value of integrated information opens the door to advanced computing applications that automate routine tasks for reduced errors, which will free the staff to perform higher order tasks.

The DoD future common Command and Control Capability, now called Network Centric Enterprise Services (NCES) will include the MIP developed JC3IEDM defined exchange schemas. The Army's Future Combat System (FCS) is using the JC3IEDM as their initial information model. Using this mature and robust model as their point of departure for their internal and external information model gives the FCS program a significant leap-ahead in technology that will enable the FCS program to advance quickly while minimizing developmental risks and maintaining links to existing US and multinational systems. The MIP developed JC3IEDM has been adopted by the simulations community as the standard interface language for use between C4I systems and simulations. Having this common language as a reference and design-to specification eases the development and integration, making real-time simulations support for commanders and staffs in actual operations for "what-if" sessions" possible.

The United States Marine Corps has adopted the MIP developed Data Model, as reported to congress (BG Allen, April 6, 2006) to facilitate inter-service, interagency, and international interoperability. This will lead to better interoperability between Army and Marine forces, not to mention the coalition interoperability the Marine Corps will achieve by adopting an existing proven capability. Figure 3.8-1 is a screen shot of the Portuguese C2IS displaying a Joint Operational Picture with maritime and air situation in relationship with a ground scenario, all rendered from the common
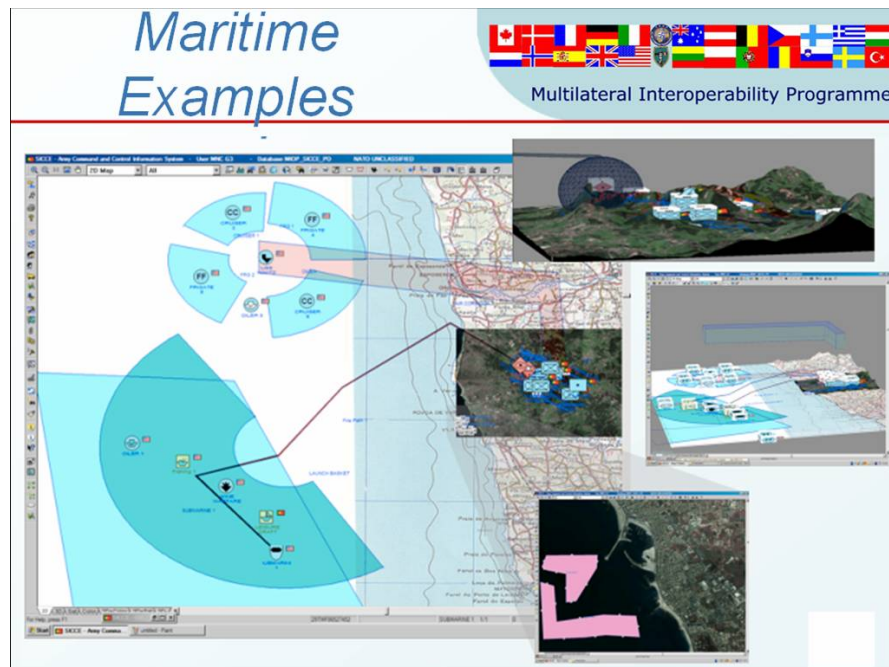
data model.

Figure 3.8-1 Example Joint Operational Picture using C2IEDM Data

NATO has formalized its relationship with the MIP community to ensure convergence in direction by policy and by becoming a member of MIP, participating in various working groups helping shape the MIP solution. (NATO, 2002)

MIP creates the opportunity for military officers, systems engineers, software developers, and test engineers to meet, work on common problems and develop long-term relationships, both personal and professional. These relationships provide an excellent resource to research for other issues not necessarily concerned with MIP. An example of the enhanced relationship involves the NATO Senior Land IER Panel where several members are also MIP representatives. This existing relationship and familiarity between members facilitates communications and effectiveness, and gains synergy ensuring convergence in solutions.

4   CONCLUSION

The United States will always conduct military operations as part of a coalition or alliance. Our forces must be able to operate in a command, support, or proximity relationship in international operations. The nature of the Global War of Terror and future actions has our forces in coalitions with ex-adversaries and non-governmental organizations, along with our long standing alliances. All of these circumstances dictate that our command systems must be able to dynamically establish relationships and effectively operate with those and only those organizations in the operation, while retaining the ability to operate with all of them. It is cost and schedule prohibitive to attempt to solve this operational problem in the traditional bilateral interoperability approach which leads to an unmanageable number of interfaces. This makes the MIP Open-Source multinational approach the only practical operational, programmatic, and technical approach that solves our collective interoperability need. MIP is on the critical path of achieving a Joint, Army, and coalition command capability. To use an example from "The World is Flat", IBM was faced with either continuing to develop a proprietary product to compete with, or adopt and build their business based on an open source product; IBM choose to adopt the open source product and were successful. DoD is in a similar position with MIP in that they can adopt the MIP and NATO products as a baseline to build upon, or continue development, or they will be faced with $N*N^2-1$ number of interfaces to develop and maintain.

MIP is a living example of what a COI is, how it functions, and what its products should be. The MIP is an exemplar Organization, Process, and set of products for the Army and joint developmental communities to follow on the path to Net-Enabled Battle-Command. Future US Army forces must be lighter, more agile, and more survivable, all qualities that rely on interoperability among mission partners which may include other elements of DoD, other US Government and non-government organizations, and sometimes the most important, coalition forces. MIP products provide an excellent baseline for the development of an integrated data centric Joint, Coalition, and Interagency/NGO Net-Enabled Battle Command Capability that will be suitable and effective in peace, Crisis Response, Peace Support, and War operations, achieving the Army Transformation goals

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